THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 20

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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Ex parte KENJI TSUJI

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Appeal No. 95-3885
Application 08/172,051[1]

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HEARD: April 5, 1999

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Before BARRETT, FLEMING and HECKER, ***Administrative Patent Judges***.

FLEMING, ***Administrative Patent Judge***.

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[1] Application for patent filed December 23, 1993.

DECISION ON APPEAL

This is a decision on appeal from the final rejection of claims 1, 3 and 5 through 8, all of the claims pending in the present application. Claims 2 and 4 have been canceled.

The invention relates to a diode suited for absorbing a surge utilizing a high resistivity layer to heat the pn junction during overcurrent so as to cause a secondary breakdown of the diode whereby a surge current is absorbed by utilizing Zener breakdown of the pn junction.

The independent claim 1 is reproduced as follows:

1. A diode comprising:

a semiconductor substrate;

a pn junction provided in the semiconductor substrate; and

an exothermic body for heating the pn junction under an overcurrent, said exothermic body being provided in a neighborhood of the pn junction wherein the exothermic body is a semiconductor layer formed below the pn junction.

The Examiner relies on the following references:

Shockley 3,286,138 Nov. 15, 1966

Richard S. Muller and Theodore I. Kamins, ***Device Electronics for Integrated Circuits***, 257 (2nd ed., New York, John Wiley & Sons, 1986).

John Gosch, "Temperature Range of Silicon Sensors Tops 350EC Mark," ***Electronics***, 73-74 (May 5, 1982).

Claims 1, 3 and 5 through 8 stand rejected under 35 U.S.C. § 103 as being unpatentable over Muller, Shockley and Gosch.

Rather than reiterate the arguments of Appellant and the Examiner, reference is made to the brief and answer for the respective details thereof.

OPINION

We will not sustain the rejection of claims 1, 3 and 5 through 8 under 35 U.S.C. § 103.

The Examiner has failed to set forth a ***prima facie*** case. It is the burden of the Examiner to establish why one having ordinary skill in the art would have been led to the claimed invention by the express teachings or suggestions found
in the prior art, or by implications contained in such teachings or suggestions. ***In re Sernaker***, 702 F.2d 989, 995, 217 USPQ 1, 6 (Fed. Cir. 1983). "Additionally, when determining obviousness, the claimed invention should be considered as a whole; there is no legally recognizable 'heart' of the invention." ***Para-Ordnance Mfg. v. SGS Importers Int'l, Inc.***, 73 F.3d 1085, 1087, 37 USPQ2d 1237, 1239 (Fed. Cir. 1995), ***cert. denied,*** 117 S.Ct. 80 (1996)

citing W. L. Gore & Assocs., Inc. v. Garlock, Inc., 721 F.2d 1540, 1548, 220 USPQ 303, 309 (Fed. Cir. 1983), ***cert. denied***, 469 U.S. 851 (1984).

On pages 12 through 20 of the brief, Appellant argues that Muller, Shockley and Gosch fail to teach Appellant's claimed limitations. In particular, Appellant argues

that Muller, Shockley and Gosch fail to teach forming an exothermic body below a pn junction for heating the pn junction under an overcurrent as claimed in Appellant's claim 1. Appellant further argues that Muller, Shockley and Gosch fail to teach forming a first epitaxial layer of a first conductivity type with a high resistivity between a semiconductor substrate and a second epitaxial layer as claimed in Appellant's claim 5. Finally, Appellant argues that Muller, Shockley and Gosch fail to teach providing an exothermic body below a pn junction and between a semiconductor layer and a substrate as claimed in claim 8.

In the answer, the Examiner argues pages 3 and 4 as well as on pages 6 and 7 that the prior art teaches the claimed structure and that the combination of Muller, Shockley and Gosch is proper. In particular, the Examiner points out on page 3 that Muller teaches "an ordinary diffused diode of a p-type region into an n-type layer." The Examiner does not rely on Muller for

the teaching of an exothermic body as recited in Appellant's claims 1 and 8 or for the teaching of a first conductivity type with a high resistivity between a semiconductor substrate and a second epitaxial layer as recited in Appellant's claim 5. The Examiner argues that Shockley and Gosch teach a semiconductor thermal resistor. However, the Examiner states on page 3 of the answer that Shockley and Gosch fail to teach placing the semiconductor thermal resistor below a pn junction of the diode. The Examiner argues that Shockley and Gosch suggest to one of ordinary skill in the art to modify the Muller diode to place the semiconductor thermal resister below a pn junction of the Muller diode in order to achieve stabilizing results as taught in Shockley.

As pointed out by our reviewing court, we must first determine the scope of the claim. "[T]he name of the game is the claim." ***In re Hiniker Co.***, 150 F.3d 1362, 1369, 47 USPQ2d 1523, 1529 (Fed. Cir. 1998).

Turning first to Appellant's claim 1, we note that the claim recites a "diode comprising: a semiconductor substrate; a pn junction . . .; and an ***exothermic body for***

heating the pn junction under an overcurrent, said exothermic body being provided in a neighborhood of the pn junction wherein the

exothermic body is a semiconductor layer formed below the pn junction." Emphasis added. Thus, Appellant's claim 1 requires a diode having an exothermic body for heating the pn junction under an overcurrent.

Upon a careful review of Muller, Shockley and Gosch, we fail to find that these references teach or suggest an exothermic body for heating the pn junction under an overcurrent wherein the exothermic body is a semiconductor layer formed below the pn junction. We agree with the Examiner that Muller is a general teaching of a pn-junction diode and that Muller fails to teach any additional layers. We agree with the Examiner that Gosch and Shockley teach a resistive layer, but we fail to find that either reference teaches an exothermic body placed below the pn junction for heating the pn junction during an overcurrent condition as recited in Appellant's claim 1.

Shockley teaches in column 4, line 70, through column 5, line 7, that Figure 5 shows a resistive layer 35 and a pn junction. However, Shockley shows in Figure 5 that the resistive layer 35 is not below the pn junction but placed on the exposed surface of the device. Also, see column 14, lines 53-54, and lines 74-75. Shockley teaches in column 1, lines 12-26, that a serious limitation exists in the power handling capacity

of many semiconductor devices due to thermal instability. Shockley further teaches that the thermal instability results in an unstable mode in which the current density increases in one localized region which results in localized heat buildup in this region of the device while the total external current remains substantially constant. Shockley states that these hot spots result in damage or destruction of the device.

In column 2, line 58, through column 4, line 39, Shockley explains in detail the problem by referring to schematic circuits shown in Figures 1 and 2 and the theoretical curves for the current voltage characteristics of

a transistor for a set of constant base voltages as shown in Figure 6. Shockley explains that Figure 6 shows that if the current is increased, the voltage first rises toward a maximum value and then drops producing a negative resistance.

Shockley then refers to Figure 1 which shows two transistors 11 and 12 connected in parallel to show how these transistors operate as described in Figure 6. Shockley shows that an instability can occur if one of the transistors is in a negative resistance condition. The instability will cause one transistor to carry predominantly all the current while the other carries practically no current.

Shockley then refers to Figure 3 to show his invention which solves the instability by interposing a distributed resistor, a layer of resistive material 27, in series with the emitter current path. The resistive layer 27 is disposed over the surface of the transistor and over the emitter region of the transistor. In column 4, line 68, through column 5, line 25, Shockley discloses another embodiment as shown in Figure 5 where the resistive layer is provided by n- resistive layer 35 and n+ layer 36. Shockley

teaches in column 3, line 68, through column 4, line 39, that the advantage of the resistive layer is to spread out the current as well as to prevent heat buildup in localized hot spots.

Reading Shockley as a whole, we find that Shockley teaches that the resistive layer is placed on the surface of the semiconductor device to avoid heat buildup within the device. Furthermore, Shockley teaches that heat buildup within the semiconductor device is to be avoided and thereby does not teach using the resistive layer for heating the pn junction under an overcurrent condition as claimed in Appellant's claim 1.

Gosch discloses a positive-temperature-coefficient sensor that can operate at much higher temperatures using spreading resistance principles similar to those taught by Shockley. In the figure found on page 73, Gosch discloses a structure for spreading the resistance which shows a similar resistive layer as taught by Shockley. However, we fail to find that Gosch teaches using the resistive layer for heating

the pn junction under an overcurrent condition as claimed in Appellant's claim 1.

Turning to Appellant's claims 5 and 8, we find that these claims require that the resistive layer is to be placed in between the substrate and the pn junction. In particular, Appellant's claim 5 recites a "diode comprising: a semiconductor substrate . . .; a first epitaxial layer . . . with a high resistivity being formed on the semiconductor substrate; a second epitaxial layer . . . formed on the first epitaxial layer; a semiconductor region . . . which is formed in the second epitaxial layer; and a pn junction defined between the semiconductor region and the second epitaxial layer." Also, Appellant's claim 8 recites a "diode comprising: . . . an exothermic body provided below the pn junction and between the semiconductor layer and the substrate." Thus, Appellant's claims 5 and 8 both require that the resistive layer or the exothermic body be positioned within the diode under the pn junction and between the substrate.

Upon reviewing Muller, Shockley and Gosch, we fail to find a teaching or a suggestion of placing the resistive layer within the semiconductor device which is below the pn junction and between the substrate and the pn junction. As pointed out above, Shockley's teaching would lead those skilled in the art to place the resistive layer on the surface of the device so as to avoid further heating.

The Federal Circuit states that "[t]he mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." ***In re Fritch***, 972 F.2d 1260, 1266 n.14, 23 USPQ2d 1780, 1783-84 n.14 (Fed. Cir. 1992), ***citing In re Gordon***, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984). "Obviousness may not be established using hindsight or in view of the teachings or suggestions of the inventor." ***Para-Ordnance***, 73 F.3d at 1087, 37 USPQ2d at 1239, ***citing W. L. Gore & Assocs.***, 721 F.2d at 1551, 1553, 220 USPQ at 311, 312-13.

Upon a review of the references relied upon by the Examiner, we fail to find any suggestion or reason to place the

Shockley or Gosch resistive layer within the Muller diode below

the pn junction. To the contrary, we find that the Shockley teaching would have led those skilled in the art to place the resistive layer on top of the Muller diode. Furthermore, none of the references suggest that the resistive layer is to be used to heat the pn junction, but in fact suggest that such heating is not desirable. Therefore, we will not sustain the rejection of claims 1, 3 and 5 through 8 under 35 U.S.C. § 103 as being unpatentable over Muller, Shockley and Gosch.

We have not sustained the rejection of claims 1, 3 and 5 through 8 under 35 U.S.C. § 103. Accordingly, the Examiner's decision is reversed.

REVERSED

LEE E. BARRETT Administrative Patent Judge	)	
MICHAEL R. FLEMING Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
STUART HECKER Administrative Patent Judge	)	

psb

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